Chapter 4.1 NONPOINT SOURCE ASSESSMENT, PRIORITIZATION, AND ACTIVITIES

This section of the Virginia Water Quality Assessment 305(b) Report includes an assessment at the smallest statewide hydrologic unit level[1] (hereafter referred to as either hydrologic units or just units) of nonpoint source (NPS) pollution potential. It also includes indicators for prioritizing corrective actions to unacceptable levels of NPS pollutants at the hydrologic unit level and a summary of NPS reduction activities currently underway. It has been prepared by the Virginia Department of Conservation and Recreation (DCR) to provide a comparative evaluation of the state's waters, on a hydrologic unit basis (see Table 4.1-2) for assisting in the targeting of limited resources and funds for NPS pollution protection activities to where they are needed the most.

The 2004 NPS Assessment and Prioritization study summarizes information from the Virginia Department of Conservation and Recreation, Virginia Department of Environmental Quality (DEQ), Virginia Department of Forestry (DOF), U.S. Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS), local Soil and Water Conservation Districts (SWCDs), the Department of Biological Systems Engineering (BSE) of the Virginia Polytechnic Institute and State University (VPI&SU), the Chesapeake Bay Local Assistance Department (CBLAD), the Virginia Department of Health (VDH), the Virginia Department of Game and Inland Fisheries (VDGIF), the Center for Environmental Studies (CES) at Virginia Commonwealth University (VCU), the US Environmental Protection Agency (EPA), the Chesapeake Bay Program (CBP), and other existing sources of information concerning nonpoint source impacts to Virginia waters.

There are three major components to the 2004 NPS Assessment and Prioritization study - potential pollutant loadings, water quality impairments, and biological health. The main focus is the determination of potential loadings of nitrogen, phosphorous, and sediment (hereafter referred to as NPS pollutants) by hydrologic unit by general land use categories. The evaluation of hydrologic units by impaired waters represents an actual water quality measure not necessarily related to the NPS pollutant loads. In order to prioritize clean up and protection activities, there are also determinations of which hydrologic units are of prime importance for the protection of public surface water supplies and for the protection of critical aquatic species. Details on these components follows.

NPS POLLUTION LOADINGS

The NPS Assessment of pollutant loadings was performed for the 2002 305(b) Report and has not changed from what was reported in that report. It is a calculation of the estimated edge of stream (EOS) loadings of nitrogen, phosphorous, and sediment per hydrologic unit using a model whose input data sets had spatial resolutions that were much smaller than these units.

The calculation of loads of NPS pollutants as a basis for assessing water quality by hydrologic unit is also consistent with Virginia=s participation as a partner with the EPA=s CBP in the calculations of NPS pollutant loads using the Chesapeake Bay Watershed Model (CBWM). Results from the CBWM, however, have only been obtainable for that portion of Virginia that is in the Chesapeake Bay Watershed (James, York, Rappahannock, Potomac, and Bay Coastal basins). There have been instances in the past where CBWM results and the previous state NPS assessment results have conflicted in the Chesapeake Bay portion of the state. There is also a desire by the DCR staff to have measures similar to the CBWM loads available for the non-Bay portion of the state, so that this resource could be used for programs with statewide extent.

In order to obtain statewide NPS pollution values, DCR has contracted with the CBP and the US Geological Survey (USGS) to add all of Virginia into the CBWM for Phase 5 of that model. This process

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[1] These units are technically referred to as Virginia=s sixth order (14 digit) hydrologic units. The Hydrologic Unit Geography page at www.dcr.state.va.us/sw/hu.htm contains information about these units.

has begun but will not produce NPS pollutant loads for a few more years. For the interim period, DCR contracted with the VPI&SU BSE Department to produce NPS pollutant load results similar to those of the CBWM but using a more simplified model.

The BSE evaluated a number of models for this application before choosing the Generalized Watershed Loading Functions (GWLF) model[2]. Assistance with GWLF model use, with CBWM use, and with data requirements for GWLF were provided by the Environmental Resources Research Institute at Penn State University, the CBP, and DCR respectively.

Before the GWLF model was used to develop NPS pollutant loadings for all hydrologic units in Virginia, it was calibrated to replicate CBWM results in the Chesapeake Bay drainage area. In calibrating the model for the Bay portion of Virginia, BSE aggregated CBWM model segments into larger calibration regions (10). Region development was modified during the calibration process, until the regions and their regional adjustment factors in the GWLF model sufficiently produced model output similar to that produced by the CBWM[3] for the Chesapeake Bay drainage area of Virginia. Non-Bay portions of the state were then related to one of these calibration regions and assigned the relevant factors.

The assessment runs of GWLF followed the completion of the calibration process. Whereas the CBWM uses and produces data in CBWM specific model segments (36 in Virginia), the assessment runs of GWLF used and produced data at the watershed level (493 in Virginia; the Chesapeake Bay itself was not modeled). Aside from not including factor adjustments, the assessment runs of GWLF differed from the calibration runs in that they used a new 2000 land use / land cover data set developed by DCR from a number of sources[4], and took into consideration the best management practice (BMP) installations and nutrient management planning occurring in Virginia over the five year period of 1995-2000 (when relevant) by DCR, the NRCS, CBLAD, and private plan writers. Table 4.1-1 lists the land use classification system used in the assessment runs of the GWLF model and the equivalent generalized model output land use categories. Spatially attributed BMP and nutrient management plan effects are measured as both land use changes to the aforementioned 2000 land use / land cover data set and as fractional reductions to the loadings by land use. Output from the assessment runs of GWLF are in the form of loading rates (R) per hectare (h) of NPS pollutants (p: nitrogen, phosphorous, and sediment) per land use (l: agriculture, urban, and forest) for each hydrologic unit (w). Loads (L) of each NPS pollutant per land use were calculated as:

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[2] GWLF was chosen because it was configured for continuous simulation and could produce EOS loads based on land-based loadings, fate, and transport of pollutants as does the CBWM. Both models also simulate seasonal variations, include both surface and subsurface components, and can represent both dissolved and particulate forms of pollutants.

[3] Calibration of the model to match output from version 4.3 of the CBWM required almost 200 runs of GWLF and included revisions to the model.

[4] The base for the 2000 land use / land cover data set is the National Land Cover Dataset (NLCD) from the US EPA. Agricultural uses were modified using the USDA 1997 Census of Agriculture and the National Crop Residue Management Survey from the Conservation Technology Information Center (CTIC). Additional classes were derived from processes developed for DCR by The Academy of Natural Sciences of Philadelphia (1997) using data from DCR=s confined animal databases and from the Virginia DOF.

$$R(plw) \ * \ h(lw) \ = \ L(plw)$$

For the purposes of ranking hydrologic units by NPS pollutant loads per land use, the loads per land use per pollutant were distributed to each hectare of a unit to produce a unit area load (UAL) per land use per pollutant for each watershed as follows:

$$L(plw) \ / \ h(w) \ = \ UAL(plw)$$

Multiple assessment runs were made and evaluated, with model refinements made between runs. Evaluations consisted of comparisons between calculated total basin loads from GWLF and those reported in various Tributary Strategy documents for Virginia, and by visual inspections of mapped unit area load rankings per pollutant per land use.

The output loadings provided a statewide equivalent of the types of results that Virginia has been able to obtain from the CBWM for the Chesapeake Bay drainage area of the Commonwealth over the last fifteen years.

In order to maintain a consistency with other circulating NPS assessment reports and maps, and with the manner in which this data is used, the ranking of hydrologic units for the NPS pollutant unit area loadings components for the 2004 NPS Assessment study has maintained the same division of derived values into categories that has been used before; the top 20% of the values for each component being classified as high, the next 30% being classified as medium, and the remaining 50% classified as low. This ranking methodology applies to the NPS pollutant loads only. These range definitions are not absolute, since units with equal loading values would not be divided into different classes.

Information regarding the NPS pollutant loadings by general land use and as summations per pollutant is found within the following sections.

Agricultural NPS Pollution Loads

Agriculture is a large and diverse industry in Virginia and accounts for approximately 24 percent of Virginia's land use. While this percentage is significantly lower than the national average and is declining in Virginia, agricultural activities continue to be the most significant source of nonpoint source pollution in the state. The current assessment model results suggest that about 70% of the total NPS nitrogen load in Virginia is from agricultural land. Likewise, over 60% of the total NPS phosphorous and sediment loads are reported to come from agricultural land.

Nonpoint source contamination from agriculture originates from several different sources with different associated impacts. Deposition of potential NPS pollutants to agricultural lands in the form of fertilizers and animal manures affect water quality when they reach groundwater reserves or are washed into streams, lakes, etc during rain storms in either a dissolved state or with eroding soils. Factors in this assessment which affect the amount of loads reaching water from agricultural lands include the erodability of the soils, types of agricultural practices, types and numbers of farm animals, land cover, stream density, rainfall, seasonal variations in plant growth and nutrient applications, existence and type of agricultural BMPs, soil saturation, and slope.

The ranked unit area loadings by hydrologic unit of nitrogen, phosphorus, and sediment from agricultural land uses are displayed in Figures 4.1-1, 4.1-2, and 4.1-3 respectively. The rankings are also listed in Table 4.1-3.

Urban NPS Pollution Loads

Although only 7 percent of the land in Virginia is considered urban, urbanization of forest and agricultural land is occurring at a rapid rate in many parts of the Commonwealth. This urbanized growth results in NPS pollution as the result of precipitation washing nutrients, sediment, and other toxic substances from the impervious surfaces that make up these areas. The sources of these surface contaminants include: air and rain deposition of atmospheric pollution; littered and dirty streets; traffic by-

products such as petroleum residues, exhaust products, heavy metals and tar residuals from the roads; chemicals applied for fertilization, control of ice, rodents and other pests; and sediment from construction sites. Illegal industrial, commercial and domestic hook-ups to storm sewers also contribute a number of specific pollutants to waterways, as do inadequate sewage disposal systems both for municipalities and individual homes.

Table 4.1-1   Land Use Classification

Original Class	Derived Class	Modeled Class	General Output Class
Evergreen Forest Deciduous Forest Mixed Forest Woody Wetlands Emergent Herbaceous Wetland		Forest	Forest
Bare: Transitional		Disturbed Forest	
Row Crop	Conventional Tillage Conservation Tillage	Conventional Tillage Conservation Tillage	Agriculture
Hay/Pasture	 Pasture Cattle-Grazed Pasture Poultry Litter Manure Acres	Hay Pasture Pasture Cattle-Grazed Pasture Poultry Litter Manure Acres	
Commercial/Industrial High Intensity Residential Low Intensity Residential Urban/Recreational Grasses Bare: Quarries and Pits Bare: Rock and Sand	 Wooded Residential	Impervious Urban & Pervious Urban	Urban

This assessment measured the nutrient and sediment loads from urban areas as opposed to all urban NPS pollutants as described. Factors in this assessment that affect the amount of loads reaching water from urban lands include the degree of imperviousness of the urban land use, impervious area NPS pollutant build-up rates, stream density, rainfall, septic system use, direct discharges, soil saturation, and slope.

The ranked unit area loadings by hydrologic unit of nitrogen, phosphorus, and sediment from urban land uses (as described in Table 4.1-1) are displayed in Figures 4.1-4, 4.1-5, and 4.1-6 respectively. The rankings are also listed in Table 4.1-3. The highlighted units are reflective of the areas of Virginia which are undergoing the most significant urban development activity. Urban load measures are based on pollution potential and do not compensate for urban runoff control measures that may be in place in some areas. Such reduction measures are primarily installed by the private sector.

Forestry NPS Pollution Loads

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About 68 percent of the land area of Virginia is forested. Although forestland in general produces little to the NPS pollutant loads, certain forest disturbing activities such as tree harvesting, site preparation, and reforesting do make a load contribution. Due in large part to the extensiveness of forest lands in Virginia, about 17% of the total NPS nitrogen load in the Commonwealth may come from forests according to model output, as does over 30% of the total NPS phosphorous and sediment load.

The classification of land cover imagery can captures bare land and regrowth areas from the aforementioned forest activities. It also captures forestland being cleared due to other land disturbing activities as well. The Virginia DOF has been tracking such activities of the forest industry to facilitate the proper management of Virginia's forest resources relative to water quality. For this study the DCR staff endeavored to define the forest disturbing activities found in the imagery so as to associate the resulting (perhaps temporarily) barren lands with the most appropriate land use being used in the GWLF model runs. Transitionally barren land was found to more closely correlate to forest harvesting activities than to urban related activities. Therefore most transitionally barren land was associated with the forest land use as opposed to other types of barren lands, which were associated with urban land use. As a result, barren mine lands add to urban loads in this study while forestland disturbed by mining activities adds to the forest loads.

Whereas agricultural activities operate on a yearly or seasonal cycle on agricultural lands, a single cycle of forest harvesting, site preparation, and reforestation occurs over many years. Where the next cycle begins amongst existing forested lands is undetectable from previous land cover images, making the measure of forest disturbance for these activities more of a snapshot than a trend.

Factors in this assessment which affect the amount of loads reaching water from forest lands include the erodability of the soils, existence of disturbed forest lands, stream density, rainfall, existence of forest (silviculture) BMPs, soil saturation, and slope.

The ranked unit area loadings by hydrologic unit of nitrogen, phosphorus, and sediment from forestland uses are displayed in Figures 4.1-7, 4.1-8, and 4.1-9 respectively. The rankings are also listed in Table 4.1-3.

Total Loads Per NPS Pollutant

Calculated total nitrogen, total phosphorous, and total sediment unit area loads from all land uses combined are displayed in Figures 4.1-10, 4.1-11, and 4.1-12 respectively, and listed in Table 4.1-3. In the GWLF model as operated by BSE, total nitrogen is composed of septic nitrogen, groundwater nitrogen, dissolved nitrogen from various land uses, washoff of nitrogen from impervious surfaces, and sediment attached nitrogen. Total phosphorous is composed of septic phosphorous, groundwater phosphorous, dissolved phosphorous from various land uses, washoff of phosphorous from impervious surfaces, and sediment attached phosphorous. Total sediment is the sediment yield from all land uses.

The summing of NPS pollutant loads by land use into total NPS pollutant loads in this NPS assessment is simply the addition of values with equivalent units (kg/ha of nitrogen or phosphorous, Mg/ha of sediment). Accordingly, the relative weight of the estimated NPS pollutants coming from one land use versus another is directly comparable. This comparison shows that NPS pollutants from agricultural lands dominate the total NPS pollutant loads.

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IMPAIRED WATERS

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In accordance with US EPA guidance and protocol, the DEQ assembled a list of the water quality limited riverine, lacustrine, and estuarine waters of Virginia in 2002 (303d report). The final version of the 2002 list of water quality limited waters is the basis for the impaired waters portion of the 2004 NPS Assessment study. It will differ slightly from the results published in the 2002 305(b) Report, since only the draft 2002 303(d) Report was available at that time, and from other portions of this 305b report that may refer to waters on the 2004 list. The 2004 list was not available in time to perform for this report the spatial analysis required for NPS analysis.

Waters listed in the 303(d) do not meet one or more of the EPA's five designated uses for water.

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Among the many defined attributes in the impaired waters database is the name of the impaired waters, the beginning and ending limits of the impaired portions, impairment causes, and impairment sources. Using this database information, a graphic depiction (layer) of the impaired waters was developed. Only waters listed by the DEQ staff as having NPS related sources or those waters not explicitly listed as having an NPS source but which (a) did not explicitly list any other sources, and either (b) listed possible agriculture related impairment causes[5] or (c) correlated with DCR's areas of nonpoint sources, were considered in this analysis.

Waters in the impaired waters layer that are suspected of being impaired due to non-point sources were divided by the hydrologic unit boundaries into segments by unit to allow for the summation of impaired water lengths or areas by these units. The same process performed on all waters in the state determined the total available miles of riverine, acres of lacustrine, and square miles of estuarine waters per hydrologic unit to compare against the impaired portions.

Riverine Impairments

Summed lengths of impaired riverine water features in 2002 as miles per hydrologic unit were compared to the total miles of riverine systems available per unit to determine the percentage of the available riverine water miles per unit that were impaired. For ranking purposes the highest 10 percent of those percentages were assigned the highest NPS rank for riverine impairments. The next 20 percent were assigned the medium rank, and the others were assigned the lowest rank. The rankings of hydrologic units for impaired riverine waters are displayed in Figure 4.1-13 and listed in Table 4.1-3.

Estuarine Impairments

Since most of the impaired main stem estuarine water bodies in Virginia have listed impairment causes that are not considered to be due to (with any significance) practices occurring in the watershed that the main stems flow through, the estuarine waters were divided into the categories Amain stem≅ and Anon main stem≅. Main stem impairment sources are considered to be more broadly dispersed in the basin, including the upstream portions of the basin that are beyond the estuarine system. To prevent the implication that the hydrologic units through which these main stem estuarine waters flow are responsible for the large amount of impaired estuarine waters in their domain, and erroneously ranking them accordingly, main stem estuarine waters were not included in the summing of impaired or available estuarine waters per unit. Summed areas of non main stem impaired estuarine waters in 2002 as square miles per hydrologic unit were compared to the total square miles of non main stem estuarine waters available per unit to determine the percentage of non main stem estuarine waters in a unit that were impaired.

Most of the 494 watersheds in Virginia do not contain estuarine waters. With the further disqualification of those that contain only main stem estuarine waters, only 66 watersheds were included in the ranking of impaired estuarine waters.

Of the hydrologic units included in the impaired estuarine waters ranking process, about 30% contained some impaired non-main stem estuarine waters. A clear gap existed in the percentage values such that all units with more than 50% impaired waters were ranked high and the other units were ranked medium. Watersheds with no impaired non-main stem estuarine waters were assigned the lowest rank.

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[5] This included all fecal causes of unknown sources since approximately 90% of all fecal problems are surmised to be due to agricultural or natural animal loadings. Similarly, because about 85% of benthic impairments are believed to be sediment related, and because DEQ personnel are more likely to know and document point sources of benthic impairments, all benthic impairments of unknown sources are considered to be NPS related. Impairments with nutrient sources were also included.

The rankings of hydrologic units for impaired non-main stem estuarine waters are displayed in Figure 4.1-14 and listed in Table 4.1-3.

Lacustrine Impairments

Unlike the 1998 303(d) listing, the 2002 listing included impaired lake and reservoir waters. It was particularly necessary to divide impaired lake waters by hydrologic unit because some of the larger reservoirs in the state were impaired or contained impaired portions, and these large bodies of water spanned multiple hydrologic units. Summed areas of impaired lacustrine waters in 2002 as acres per hydrologic unit were compared to the total acres of lacustrine waters available per unit to determine the percentage of lake waters in a unit that were impaired.

The vast majority of the hydrologic units in Virginia contained no impaired lake or reservoir waters in 2002 and so were ranked low. Of those that did, a few had very minor percentages and were therefore also ranked low. Conversely, a few had significant impaired portions (>50%) and were therefore ranked high. All others were ranked medium. The rankings of hydrologic units for impaired lacustrine waters are displayed in Figure 4.1-15 and listed in Table 4.1-3.

BIOLOGICAL HEALTH

Also included In the 2004 NPS Assessment and Prioritization study is information from VDH on public surface water sources and their protection zones, and an evaluation of the health of aquatic species in the state=s waters by the CES at VCU. Both of these components were used in the 2002 NPS Assessment and Prioritization study and are repeated here without change. They provide an additional means to prioritize water quality protection - the protection of the sources of public drinking water and of natural aquatic communities, respectively.

Public Source Water Protection

As part of their Source Water Area Protection (SWAP) Program, the VDH determined the area upstream of public surface water intakes that must be investigated for threats to water quality. The most immediate area of their concern is referred to as the Zone 1 for each intake. Zone 1 areas extend out to a 5-mile radius upstream from a water supply intake or 5 miles around a lake containing an intake, without crossing watershed boundaries except those upstream. The population served by an intake, provided by VDH, and the portion of a hydrologic unit that is within a Zone 1 area has been used by DCR to calculate the concentration of persons served per unit by these public surface water supplies. The concentration values serve as a measure of the importance of high water quality by hydrologic unit for public drinking water supply protection. The categorized values are displayed in Figure 4.1-16 and listed in Table 4.1-3. Concentration values are the summation by hydrologic unit of all Zone 1 areas or combinations of Zone 1 areas in that unit times one one-thousandth of the effective population each serves. In cases where a municipality owned several intakes, the single recording of population served was divided amongst each intake to create an effective population served. In cases of overlapping intake reaches the effective population of each reach was summed for the portion of overlap.

Many hydrologic units contained no Zone 1 protection zones or portions of Zone 1 protection zones. The vast majority of those with some Zone 1 content had low levels (< .38) of the calculated measure for concentrations of people served within a watershed. Of the remaining units, a few had significantly higher value measures (> 92) and were therefore classified as AVery High≅. The rest were divided among a moderate category (.38-2.4) and a high category (2.5-91).

Aquatic Species Measures

The presence or absence of certain aquatic species can serve as an indication of the overall quality of a particular waterway. They can also indicate where the most biological damage can occur from water quality degradation. Accordingly, the NPS Assessment and Prioritization study provides a ranking of hydrologic units for stream-dependent living resources (including fish, mollusks, and crayfish) using a multi-metric index calculated by the CES at VCU. These indexes (referred to as AminiMIBI≅ B a minimized version of the Modified Index of Biological Integrity) were calculated by the CES using

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databases originally developed by DCR, the VDGIF, and VCU. The DCR database contained information for approximately 600 fish records, representing over 50 species, and over 1,300 mollusk records, representing almost 50 species. The VDGIF database contained information for over 135,000 fish records, representing over 220 unique species, and close to 7,000 mollusk records.   Additionally, the VCU dataset contained information for over 5,500 fish records. By assigning a hydrologic unit code to each of the recorded species in the various databases, metric scores by unit were developed for each of 6 metrics. These metrics are as follows:

> Metric 1 - Taxonomic Richness: refers to the total number of unique species found in a unit.
> Metric 2 - Native Species Richness: refers to the number of indigenous (local) species present in a unit.
> Metric 3 - Number of Rare, Threatened and Endangered Species: refers to the number of species that are considered rare, threatened or endangered due to their low population levels that are present in a unit.
> Metric 4 - Number of Non-indigenous Species: refers to the number of non-native species present in a unit. These are introduced species that would not normally be found in this particular location.
> Metric 5 - Number of Critical Species: refers to the number of species found in a unit that are considered critical because of some important role that they play, such as being a food source or major recreational fishery.
> Metric 6 - Number of Tolerant Species: refers to the number of species found in a unit that are tolerant to degraded stream conditions and can survive even in these sub-optimal conditions.

A score for each metric per hydrologic unit was assigned by the CES. A score of zero was given if insufficient data was available. Metrics 4 and 6 were reversed in the scoring, so that a low value for either of these metrics would receive a high score. Lower values are more desirable in metrics 4 and 6 because a high number of non-native species and/or a high number of species that are tolerant to stream degradation are less desirable characteristics for a stream. The scores for each metric for each unit were totaled to give an overall total miniMIBI score per hydrologic unit.   A category value of High (score of 5), Medium (score of 3), or Low (score of 1) was assigned on a per basin basis based on the total miniMIBI score. Summed scores per hydrologic unit were thusly tiered relative only to the summed scores of the other units in the same basin.   The total miniMIBI scores are used to place each hydrologic unit into ranked categories reflecting biotic integrity and resource importance.

Figure 4.1-17 displays, and Table 4.1-3 lists, the categorization of the miniMIBI scores by hydrologic unit. Since there were 6 metrics, and a maximum score of 5 could be obtained for each metric, the overall maximum score a unit could receive was 30 (6 x 5). A majority (197) of the total miniMIBI scores were 14. The 180 hydrologic units with total miniMIBI scores below this average may represent waters with some degree of degradation, but they may also reflect waters where insufficient studies and inventories have occurred. This latter condition is particularly true for coastal watersheds, and is being addressed in further cooperative efforts by the CES, VDGIF, and DCR. The hydrologic units with miniMIBI scores above 14 are divided here into two categories based on their Metric 3 scores. Since the occurrence of rare, threatened, and endangered species is of particular importance to DCR and the VDGIF, units with a maximum score for Metric 3 have been highlighted from those with less than a maximum Metric 3 score.

While the maintenance or enhancement of water quality for the protection of all native aquatic life is the preferred goal, the aquatic species priorities shown should help direct NPS pollution mitigation efforts and other water quality improvement projects toward hydrologic units with the most important aquatic resources.

NPS REDUCTION ACTIVITIES

Efforts to reduce NPS pollution in Virginia have been undertaken by a full range of government agencies - federal, state, regional, and local, as well as by citizen action. In many cases the activities are cooperatively performed and funded. The Annual 2002 Virginia Nonpoint Source Pollution Program Report, found at www.dcr.state.va.us/sw/, contains descriptions of the cooperative NPS reduction activities. Most of these efforts target particular watersheds. Among them, and elaborated on here for a

basin level comparison, are the Total Maximum Daily Load (TMDL) studies and implementation, Tributary Strategies, cost share incentive programs for Best Management Practices (BMP), and incentives for the set aside of agricultural land.

Total Maximum Daily Loads

TMDLs, described earlier in this 305(b) report, are performed for waters that have been determined to be impaired and are so listed in the State=s 303(d) report. Waters are not listed as impaired, however, due to high concentrations of nitrogen, phosphorous, or sediment, but rather because they cannot support, or can only partially support, one or more of the five designated uses.   This is because water quality standards do not exist for concentrations of these NPS pollutants. Nevertheless, certain impairment causes are primarily due to nonpoint source pollutants (see Impaired Waters in this chapter) and DEQ staff has often determined that there are nonpoint sources for these impairments.

Using the logic of the impaired waters rankings of the NPS Assessment study, all impairments for which one or more of the stages of a TMDL have begun were divided between those with and those without a nonpoint source. Most of the waters declared impaired in Virginia are, or are believed to be, impaired due to, or partially due to, nonpoint source pollution. Consequently, most of the TMDLs that are being undertaken have a nonpoint source component. These studies are focusing on identifying the sources of the impairment causes, quantifying the loadings of these sources to the water, and determining the reduction in loads needed in order to meet the use criteria. The development of an implementation plan is expected following the completion of a TMDL study for a particular watershed. Implementation of the plan's course of action then follows.

By the end of 2003 there were 59 completed TMDL studies for NPS impaired watersheds. Of these, 20 are having implementation plans developed at this time. There are 88 other TMDL studies underway on nonpoint source impaired watersheds. Table 4.1-4 lists these TMDLs by stage.

 Whereas it is streams or water bodies that are listed as impaired, it is the watershed of those impaired stream segments and water bodies that are the focus of nonpoint source pollutant reduction activities. The hydrologic units listed in Table 4.1-4 are those that some portion of the listed impaired stream segments are within. Sometimes the entire area of the listed hydrologic unit is the watershed of the impaired stream segment, but often only a portion of that unit must be studied for a TMDL. Figure 4.1-18 shows the true TMDL study areas and thus gives a better indication of the geographic extent of where the work is being performed.

Agricultural Cost Share Program

The Virginia Agricultural Cost Share Program offers incentives to farmers and agricultural landowners to encourage the installation and use of a number of approved techniques (known as BMPs) for reducing agricultural related nonpoint source runoff. While the program aims to address nonpoint source pollutants statewide, specific hydrologic units are targeted based on the agricultural loads estimated from the NPS Assessment study (see Agricultural NPS Pollution Loads). Soil and Water Conservation Districts further target the practices to individual needs within their district within these load priority areas.

Funding for the implementation of these practices has been borne by the state and the federal government since the program=s inception in 1985. The number of installations increased in 2000 and 2001 with an increase of funding from the Water Quality Improvement Act (WQIA), but the WQIA Fund has not been funded in the past two years. Subsequently, installations have dropped. Table 4.1-5 contains the estimated NPS pollutant reductions by basin for 2002 and 2003, as well as the state=s costs to attain these reductions, from the Virginia Agricultural Cost Share Program alone. Other efforts, such as from the USDA, increase these reductions. Additional information on agricultural best management practices can be found at www.dcr.state.va.us/sw/costshar.htm

Conservation Reserve Enhancement Program

The USDA=s Conservation Reserve Program (CRP) provides incentives for the removal of

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agricultural land from production to protect environmentally sensitive land alongside rivers and streams. The Virginia Conservation Reserve Enhancement Program (CREP) augments CRP by providing for additional set asides as well as by providing funding for land owner implementation of other conservation practices as well as for the purchase of conservation easements.

Most areas of the state qualify for CREP assistance. Table 4.1-5 contains the estimated reduction of nonpoint source pollutants by basin for 2002 and 2003, as well as the state=s costs to attain these reductions, from the Virginia CREP alone. The USDA=s CRP increases these reductions. Additional information on the Conservation Reserve Enhancement Program can be found at www.dcr.state.va.us/sw/crep.htm.

Table 4.1-5   BMP NPS Pollutant Reductions and Costs, Calendar Years 2002 & 2003

	Ag Cost Share Totals				CREP Totals			
BASIN	Tons SL Reduced	Lbs N Reduced	Lbs P Reduced	State Cost ($)	Tons SL Reduced	Lbs N Reduced	Lbs P Reduced	State Cost ($)
POTOMAC	30836	167750	26591	614032	441	2398	589	31136
SHENANDOAH	19832	107883	21669	1744128	6850	37263	6615	435792
RAPPAHANNOCK	31546	171612	30531	1105485	1289	7015	1029	78005
YORK	11683	63554	10919	522703	3854	20966	3111	606632
JAMES	36691	199597	37144	1210920	4197	22833	4794	539935
BAY COASTAL	66900	363938	91365	270910	353	1918	283	51782
OCEAN COASTAL	27922	151895	37033	65440	83	452	104	11797
ALBEMARLE SOUND	1471	8003	1471	39781	18	96	18	400
CHOWAN	7451	40533	10859	149856	1171	6373	1645	145051
ROANOKE	49336	268387	53354	165600	1912	10400	1900	153198
YADKIN	1115	6066	1115	6495	3514	19116	3629	357139
NEW	16742	91075	16012	216046	7583	41252	7554	165957
CLINCH/POWELL	9230	50212	9589	125504	242	1316	300	56084
HOLSTON	106806	581025	113985	201772	1574	8562	1894	237880
BIG SANDY	143	775	143	1500	14	76	14	158

Tributary Strategies

Tributary Strategies are basin wide water quality attainment plans. They are part of the State=s Chesapeake Bay Program commitment, and thus are described in that chapter of this 305(b) report. Plans are currently being updated for the James River Basin, Rappahannock River Basin, York River Basin, Potomac River Basin, and the Eastern Shore of Virginia. The goals of these plans both directly specify nonpoint source nutrient load reductions needed for water quality attainment and specify attainment measures that will require nonpoint source pollutant reductions. Consequently, significant amounts of nonpoint source pollutants must be reduced to achieve these plans, at considerable cost. More information on the Tributary Strategies, including their current status, is available at: www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/index.cfm.